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(21) International Application Number: PCT/US99/21004 (22) International Filing Date: 14 September 1999 (14.09.99) (30) Priority Data: 09/164,607 1 October 1998 (01.10.98) US (71) Applicant: ERICSSON INC. [US/US]; 7001 Development Drive, Research Triangle Park, CA 27709 (US). (72) Inventor: PHILLIPS, John, Charles; 9916 Bonsal Crossing, New Hill, NC 27562 (US). (74) Agent: FREEMAN, John, C.; Brinks Hofer Gilson & Lione, P.O. Box 10087, Chicago, IL 60610 (US).		(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG). Published With international search report.
(54) Title: CELLULAR TELEPHONE WITH SEQUENTIALLY LIGHTED KEYPAD		
(57) Abstract <p>Telephone comprising transparent keys and a source of light underneath each transparent key. Each source of light is individually controlled in response to the activation of the corresponding key.</p> <div data-bbox="893 1155 1380 1848"> <pre> graph TD A[Any Key is Pressed] --> B[Key tone sounds] B --> C[Appropriate LED is illuminated for time t] C --> D{Is another key pressed?} D -- Yes --> E[extinguish existing key LED and light new LED for time t] E --> C D -- No --> F[Continue illumination until time out] F --> G([END]) </pre> </div>		

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CELLULAR TELEPHONE WITH SEQUENTIALLY LIGHTED KEYPAD

BACKGROUND OF THE INVENTION

Field of the Invention

5 The present invention relates to a telephone, such as a cellular telephone, that has a keypad.

Discussion Of Related Art

10 In the past, telephones employed keypads where the entire keypad was backlit. Such keypads offer little variety in the presentation of the keypad during its use. Consequently, the keypad does not add to the interest or fun in using the telephone.

SUMMARY OF THE INVENTION

15 One aspect of the present invention regards a telephone having an earphone, a microphone and a partially transparent key. A source of light lies underneath the partially transparent key, wherein when the source of light is activated, light is transmitted through the partially transparent key. A light control device is connected to the source of light, wherein the light control device controls activation of the source of light upon activating the key.

20 A second aspect of the present invention regards a method of controlling a telephone with a key by activating a key of a telephone, transmitting light through the key in response to the activating step and controlling the transmitted light in response to the activating step.

25 A third aspect of the present invention regards a telephone having an earphone, a microphone and a first key that is partially transparent. A source of light lies underneath the partially transparent first key, wherein when the source of light is activated, light is transmitted through the partially transparent key. The telephone further includes a second key and a light control device connected to the source of light, wherein the light control

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device controls activation of the source of light upon activating the second key.

5 A fourth aspect of the present invention regards a method of controlling a telephone by activating a first key of a telephone, transmitting light through a second key of the telephone in response to the activating step and controlling the transmitted light in response to the activating step.

10 A fifth aspect of the present invention regards a telephone having an earphone, a microphone, a first key that is partially transparent and a first source of light underneath the first key. A second key that is partially transparent and a second source of light underneath the second key, wherein the first and second sources of light are each in a first state when the first and second keys are simultaneously not activated. A light control device is connected to the first and second sources of light, wherein the light control device changes the first source of light to a second state upon activating the first key.

15 A sixth aspect of the present invention regards a telephone having an earphone, a microphone, a first key that is partially transparent and representative of a first numerical digit and a first source of light underneath the first key. A light control device is connected to the first source of light, wherein the light control device includes a memory that contains a sequence of numerical digits that include the first numerical digit. A memory activation switch that when activated results in the sequence of numerical digits to be sequentially read from the memory and wherein when the first numerical digit is read the first source of light changes.

20 Each of the above aspects of the present invention provides the advantage of increasing variety in the presentation of the keypad during its use.

25 Each of the above aspects of the present invention provides the further advantage of adding to the interest and fun in using a telephone.

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Further advantages and details of the scanner element according to the invention will become apparent from the ensuing description of an exemplary embodiment in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

5 FIG. 1 shows a perspective view of a telephone according to the present invention;

 FIG. 2 shows a top view of the telephone of FIG. 1;

 FIG. 3A shows a block diagram of a first embodiment of a control circuit used with the telephone of FIG. 1;

10 FIG. 3B shows a block diagram of a second embodiment of a control circuit used with the telephone of FIG. 1;

 FIG. 4 shows a flow chart demonstrating a first mode of operation of the telephone of FIG. 1;

 FIG. 5 shows a flow chart demonstrating a second mode of
15 operation of the telephone of FIG. 1;

 FIG. 6 shows a flow chart demonstrating a third mode of operation of the telephone of FIG. 1; and

 FIG. 7 shows a flow chart demonstrating a fourth mode of operation of the telephone of FIG. 1.

20 DESCRIPTION OF THE PREFERRED EMBODIMENT

 A telephone 20 according to the present invention is schematically shown in FIGS. 1-7, wherein like elements are identified by like numerals. Note that the term telephone is meant to include cell phones. As shown in FIGS. 1 and 2, the telephone 20 includes a housing 22, an earphone 24 for
25 listening and a microphone 26 for talking. The telephone has an antenna 28 for receiving and sending wireless messages. The front face 29 of the telephone 20 also has a number of keys 30 (labeled A-R) that perform a variety of functions when activated by being depressed. For example, keys K, B, H, N, C, I, O, D, J, and P are associated with the numerical digits 0-9,
30 respectively, and are used to dial in a telephone number by pressing the

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keys associated with the telephone number. Keys A, G and M perform the functions of (1) sending a telephone number after entering the telephone number, (2) opening up a menu of functions that can be performed by the telephone 20 or muting the user during a telephone call and (3) ending a phone call and turning the telephone 20 on and off, respectively, in a well known manner when depressed. Keys E and Q represent the symbols "*" and "#" when depressed and are used to gain access to various telephone systems, such as Phone Mail. The keys E and Q are also used to scroll the menu displayed when key G is depressed. Key F is used to store or recall a stored message in a well known manner. Key L is used to clear or erase a telephone number and key R is used to raise or lower the volume of the message heard in the earphone in a well known manner. As shown in FIG. 2, indicia, such as numerals or letters, are placed on the top exterior surfaces of the keys 30 in a well known manner so as to inform the user what function will be performed by a key when activated. Note that when one or more of the keys 30 are depressed, the display 32, such as a segmented alpha-numeric liquid crystal display, displays the keys pressed or other messages or menu functions in a well known manner. While the telephone described above regards the model AH620 cell phone made by Ericsson Inc., it is understood that a wide variety of telephones can be used without departing from the spirit of the invention.

Each of the keys 30 is made of a plastic material that is partially transparent. Underneath each of the keys 30 is a corresponding source of light 34, such as a light emitting diode (LED). In other words, instead of using a single light source to light all of the keys at once, a plurality of independently illuminated sources of light 34 are placed underneath the keys 30. When a source of light 34 is activated, light is transmitted through the partially transparent key 30 directly above the activated source of light 34. An embodiment of the integrated structure of the keys 30 and sources of light 34 is described in U.S. Patent Application Serial No. 08/850,071, filed on May 2,

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1997 and entitled "Direct Key Backlighting" and whose entire contents are incorporated herein by reference.

Using a separate source of light 34 under each key 30 allows the illumination of the keys 30 to be controlled in a variety of ways. As shown in FIG. 3A, each source of light 34 is electrically connected to a light control device, such as a microprocessor 36. An example of an acceptable microprocessor 36 is Z80 microprocessor. The microprocessor 36 controls the activation of a source of light 34 upon activation of a corresponding key 30. It is understood that a wide variety of microprocessors can be used without departing from the spirit of the invention.

One mode of controlling the activation of the sources of light 34 is shown in FIG. 4. In this mode, a source of light 34 is not activated until a corresponding key 30 is depressed. Accordingly, all the sources of light 34 are normally not illuminated. However, when any of the keys 30 is depressed, a keypad scanner 37 determines which key 30 has been depressed, a tone generator 39 is activated and emits an audible key tone through the earphone 24, and the microprocessor 36 activates the corresponding source of light 34 so as to transmit light through the depressed key 30. The microprocessor 36 also controls the duration of the transmitted light to be a predetermined amount of time, T, that would be noticeable by a user. If no keys are depressed during the time period T, then the source of light 34 under the depressed key 30 will be deactivated by the microprocessor 36 at the end of the time period T. As shown in the flow chart of FIG. 4, should a second key 30 be depressed before the expiration of the predetermined amount of time, T, the microprocessor 36 simultaneously extinguishes the source of light 34 corresponding to the first key 30 and activates the source of light 34 corresponding to the second depressed key. The microprocessor 36 controls the source of light 34 for the second depressed key 30 so that it stays illuminated for an amount of time, T, or until a third key 30 is depressed, whichever occurs first.

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A second mode of controlling the activation of the sources of light 34 is shown in FIG. 5. This mode is complementary to the mode described above with respect to FIG. 4 in that (1) all of the sources of light are normally activated and (2) when any of the keys 30 is depressed and activated so as to emit an audible key tone, the microprocessor 36 deactivates the source of light 34 below the depressed key 30 so as to prevent transmission of light. The microprocessor 36 controls the amount of time that the sources of light 34 are activated and amount of time that the source of light 34 below the depressed key is deactivated to be a predetermined amount of time, T, that would be noticeable by a user. If no other keys 30 are depressed during the time period T, then the microprocessor 36 deactivates all activated sources of light 34. As shown in the flow chart of FIG. 5, should a second key 30 be depressed before the expiration of the predetermined amount of time, T, the microprocessor 36 simultaneously activates the source of light 34 corresponding to the first key 30 and deactivates the source of light 34 corresponding to the second depressed key. All the other keys 30 remain activated. The microprocessor 36 controls the activated sources of light 34 so that they stay illuminated for an amount of time, T, that is noticeable by an observer. Should a third key 30 be depressed before the expiration of the time T, then the process is repeated where the key tone for the third key is emitted and all the keys except the third key are illuminated for an amount of time T. It is understood that instead of deactivating the source of light 34, the source of light 34 corresponding to the depressed key 30 may have its intensity increased or decreased to levels that are readily distinguishable from the initial intensity level.

A third possible mode of controlling the activation of the sources of light 34 is shown in FIGS. 3B and 6. In this mode, each of the sources of light 34 is a multi-colored LED with a green colored LED 38 and a red colored LED 40 as shown in FIG. 3B. When any of the keys 30 is depressed and activated so as to emit an audible key tone, the microprocessor 36 activates all the sources of light 34 to a first state where their green LED's are

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illuminated except the source of light 34 below the depressed key 30 is activated to a second state where its red LED is illuminated. The microprocessor 36 controls the amount of time that the green and red LED's are activated to be a predetermined amount of time, T, that would be
5 noticeable by a user. If no other keys 30 are depressed during the time period T, then the microprocessor 36 deactivates all activated sources of light 34. As shown in the flow chart of FIG. 6, should a second key 30 be depressed before the expiration of the predetermined amount of time, T, the microprocessor 36 simultaneously deactivates the red LED and activates the
10 green LED corresponding to the first key 30 and deactivates the green LED and activates the red LED corresponding to the second depressed key. All the green LED's for the other keys 30 remain activated. The microprocessor 36 controls the activated sources of light 34 so that they stay illuminated for an amount of time, T, that is noticeable by an observer. Should a third key 30
15 be depressed before the expiration of the time T, then the process is repeated where the key tone for the third key is emitted and all the keys except the third key are illuminated for an amount of time T.

The first, second and third modes of controlling the activation of the sources of light 34 described above are similar to each other in that the
20 sources of light 34 are each in a first state (i.e., simultaneously not activated as in the first mode, activated so as to simultaneously emit light as in the second mode and the green LED's are activated in the third mode) when all the keys 30 are initially simultaneously not activated. Upon activation of a key 30, the microprocessor 36 changes the source of light 34 underneath the
25 activated key 30 to a second state (i.e., activated as in the first mode, deactivated, dimmed or brightened as in the second mode and the red LED is activated in the third mode) that exists for a predetermined amount of time, T.

A fourth mode of controlling the sources of light 34 is illustrated by the flow chart of FIG. 7. This mode is used when the telephone 20 has a
30 memory 42 that digitally stores one or more sequences of numerical digits associated with telephone numbers and keys 30 that are associated with

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each stored telephone number. In this mode, each of the sources of light 34 is a multi-colored LED with a green colored LED 38 and a red colored LED 40 as shown in FIG. 3B. Prior to dialing a telephone number, all of the keys 30 are associated with the numerical digits 0-9 (keys K, B, H, N, C, I, O, D, J, and P, respectively) are illuminated by their associated green LED's 38. When the memory activation switch or key 30 associated with one of the stored telephone numbers is pressed (key F), the associated telephone number's sequence of numerical digits is sequentially read from the memory 42. When the first numerical digit of the sequence is read, the dual tone multi-function tone associated with the first numerical digit sounds and the green colored LED 38 associated with the first numerical digit is deactivated and the associated red colored LED 40 is activated. After the red colored LED 40 is activated, the microprocessor 36 determines whether the entire stored sequence has been read. If the answer is no, then the next digit in the sequence is read and the above process is repeated. If the answer is yes, then no other sources of light are activated. Note that instead of changing the colors of the keys associated with the digits, the intensity of the sources of light associated with the keys can be changed, either by deactivating, dimming or brightening the source of light.

A variation of the fourth mode is to have the telephone 20 be a platform for playing a game, like the game known as SIMON. The game is activated by pressing key G and opening up a menu, that includes a list of games, including SIMON, and then depressing the keys E and Q to scroll the menu until the desired game is reached. In the case where the SIMON game is reached and selected, the memory 42 that stores a number of random sequences of numerical digits is used. When the SIMON game is reached on the menu, the memory activation switch or key 30 (key labeled A) is pressed, one of the sequences stored in the memory 42 is read in the manner described above with respect to the flow chart of FIG. 7. After the sequence is read, the user tries to repeat the sequence by pressing the keys 30 associated with the numerical digits 0-9 in an attempt to repeat the

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sequence of lights and/or tones that the user witnessed. If the user successfully repeats the sequence, then a new sequence is read and the user attempts to repeat the new sequence. If the user fails to repeat the sequence, the user loses and the game stops. A new game is started by pressing the memory activation switch 30 (key labeled A).

The invention may be embodied in other forms than those specifically disclosed herein without departing from its spirit or essential characteristics. For example, it can be used with other devices that use keypads, such as typewriters, hand held games and computer keyboards.

The described embodiments are to be considered in all respects only as illustrative and not restrictive, and the scope of the invention is commensurate with the appended claims rather than the foregoing description.

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I CLAIM:

1. A telephone, comprising:
an earphone;
a microphone;
5 a partially transparent key;
a source of light underneath said partially transparent key,
wherein when said source of light is activated, light is transmitted through
said partially transparent key; and
a light control device connected to said source of light, wherein
10 said light control device controls activation of said source of light upon
activating said key.
2. The telephone of claim 1, wherein said partially transparent key
is made of a plastic material.
- 15 3. The telephone of claim 1, wherein a surface of said partially
transparent key comprises indicia placed thereon.
4. The telephone of claim 1, wherein said key is activated upon
20 depressing said key.
5. The telephone of claim 1, wherein said source of light
comprises an LED.
- 25 6. The telephone of claim 5, wherein said LED comprises a multi-
colored LED.
7. The telephone of claim 1, wherein said light control device
activates said source of light for a predetermined amount of time upon
30 activation of said key.

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8. The telephone of claim 1, wherein said light control device deactivates said source of light for a predetermined amount of time upon activation of said key.

5 9. The telephone of claim 1, wherein said light control device changes the color of said source of light upon activation of said key.

10 10. A method of controlling a telephone with a key, the method comprising the steps of:
activating a key of a telephone;
transmitting light through said key in response to said activating step; and
controlling said transmitted light in response to said activating step.

15 11. The method of claim 10, wherein said activating step comprises depressing said key.

20 12. The method of claim 10, wherein said controlling step comprises transmitting light through said key for a predetermined amount of time.

25 13. The method of claim 10, wherein said controlling step comprises preventing the transmission of light through said key for a predetermined amount of time.

14. The method of claim 10, wherein controlling step comprises changing the color of said light through said key.

30 15. A telephone, comprising:
an earphone;

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a microphone;
a first key that is partially transparent;
a source of light underneath said partially transparent key,
wherein when said source of light is activated, light is transmitted through
5 said partially transparent key;
a second key;
a light control device connected to said source of light, wherein
said light control device controls activation of said source of light upon
activating said second key.

10

16. The telephone of claim 15, wherein said first key is made of a plastic material.

15

17. The telephone of claim 15, wherein a surface of said first key comprises indicia placed thereon.

18. The telephone of claim 15, wherein said second key is activated upon depressing said second key.

20

19. The telephone of claim 15, wherein said source of light comprises an LED.

20. The telephone of claim 19, wherein said LED comprises a multi-colored LED.

25

21. The telephone of claim 15, wherein said light control device activates said source of light for a predetermined amount of time upon activation of said second key.

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22. The telephone of claim 15, wherein said light control device deactivates said source of light for a predetermined amount of time upon activation of said second key.

5 23. The telephone of claim 15, wherein said light control device changes the color of said source of light upon activation of said second key.

24. A method of controlling a telephone with a first key and a second key, the method comprising the steps of:
10 activating a first key of a telephone;
transmitting light through a second key of said telephone in response to said activating step; and
controlling said transmitted light in response to said activating step.

15 25. The method of claim 24, wherein said activating step comprises depressing said first key.

26. The method of claim 24, wherein said controlling step
20 comprises transmitting light through said first key for a predetermined amount of time.

27. The method of claim 24, wherein said controlling step
25 comprises preventing the transmission of light through said first key for a predetermined amount of time.

28. The method of claim 24, wherein controlling step comprises changing the color of said light through said first key.

30 29. A telephone, comprising:
an earphone;

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a microphone;

a first key that is partially transparent;

a first source of light underneath said first key;

a second key that is partially transparent;

5 a second source of light underneath said second key, wherein
said first source of light and said second source of light are each in a
first state when said first and second keys are simultaneously not
activated;

10 a light control device connected to said first and second
sources of light, wherein said light control device changes said first source of
light to a second state upon activating said first key.

30. The telephone of claim 29, wherein said first state comprises
said first and second sources of light each simultaneously emitting light.

15

31. The telephone of claim 30, wherein said second state
comprises said first source of light being deactivated.

32. The telephone of claim 31, wherein said light control device
20 controls said second state to exist for a predetermined amount of time.

33. The telephone of claim 30, wherein said second state
comprises said first source of light emitting light at an intensity different than
the intensity of light emitted from said first source of light in said first state.

25

34. The telephone of claim 33, wherein said light control device
controls said second state to exist for a predetermined amount of time.

35. The telephone of claim 30, wherein said second state
30 comprises said first source of light emitting light at a visible color different

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than the visible color of light emitted from said first source of light in said first state.

5 36. The telephone of claim 35, wherein said light control device controls said second state to exist for a predetermined amount of time.

37. The telephone of claim 29, wherein said first state comprises said first and second sources of light each simultaneously being deactivated.

10 38. The telephone of claim 37, wherein said second state comprises said first source of light emitting light.

39. The telephone of claim 38, wherein said light control device controls said second state to exist for a predetermined amount of time.

15

40. A telephone, comprising:
 an earphone;
 a microphone;
 a first key that is partially transparent and representative of a
 first numerical digit;
 a first source of light underneath said first key;
 a light control device connected to said first source of light,

20

wherein said light control device comprises a memory that contains a sequence of numerical digits that include said first numerical digit;

25

 a memory activation switch that when activated results in said sequence of numerical digits to be sequentially read from said memory and wherein when said first numerical digit is read said first source of light changes.

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41. The telephone of claim 40, comprising nine additional keys representative of numerical digits different from one another and said first numerical digit; and

5 each of said nine additional keys have a corresponding source of light that changes when a numerical digit from said sequence of numerical digits is read.

42. The telephone of claim 40, wherein said sequence of numerical digits is representative of a telephone number.

10

43. The telephone of claim 40, wherein when said first numerical digit is read said first source of light changes in intensity.

15 44. The telephone of claim 40, wherein when said first numerical digit is read said first source of light changes in color.

FIG. 1

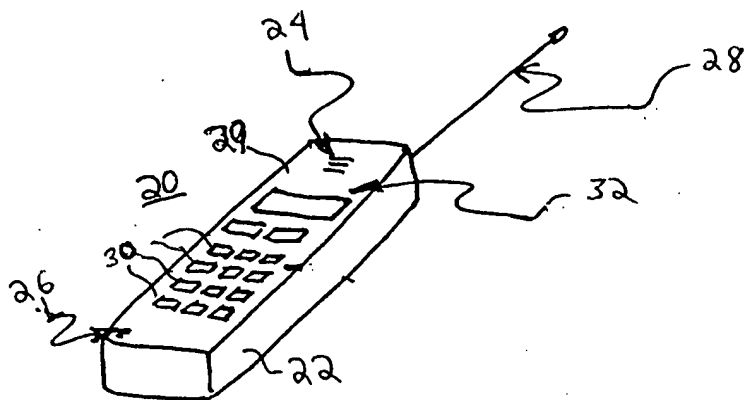


FIG. 2

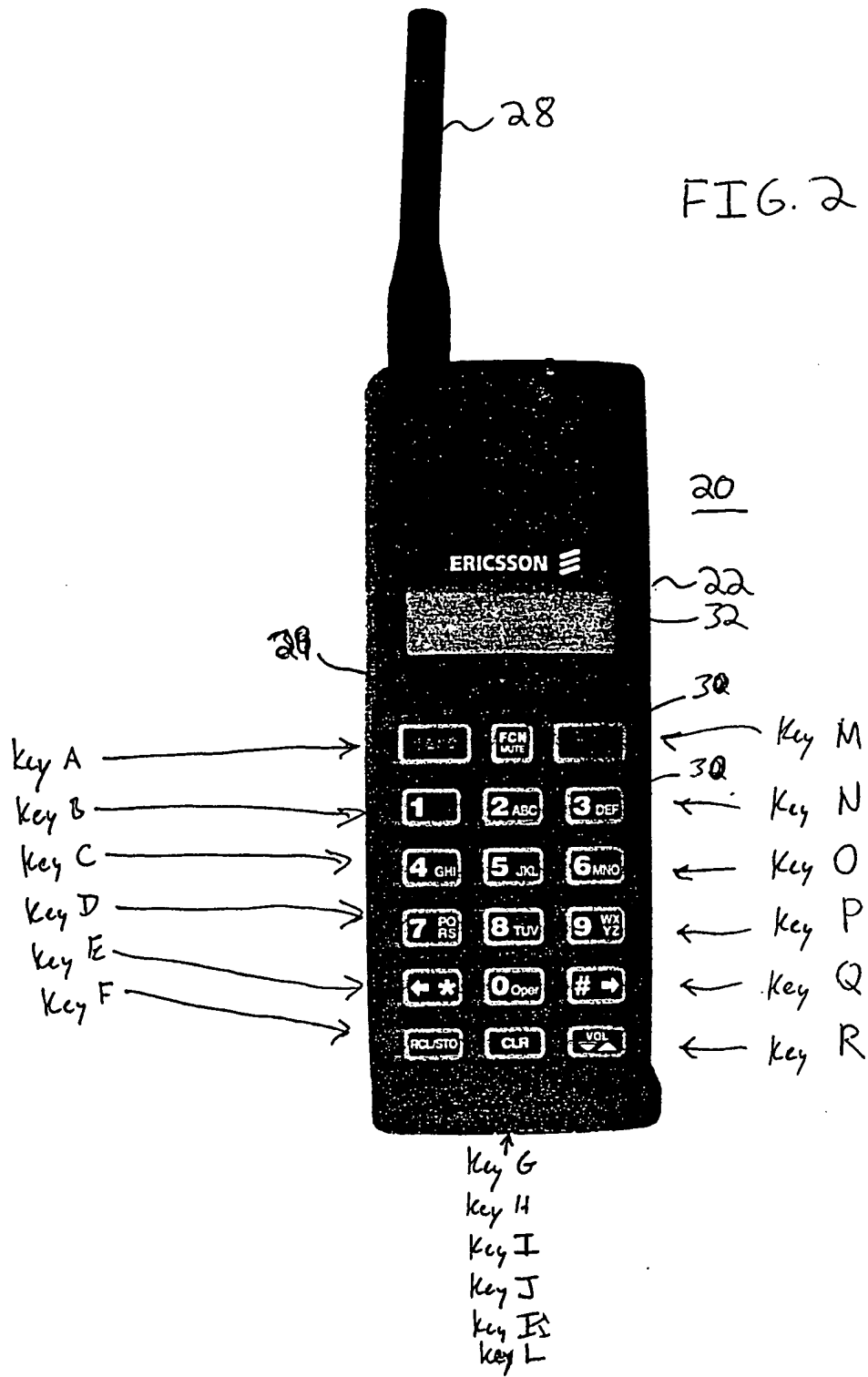


FIG. 3A

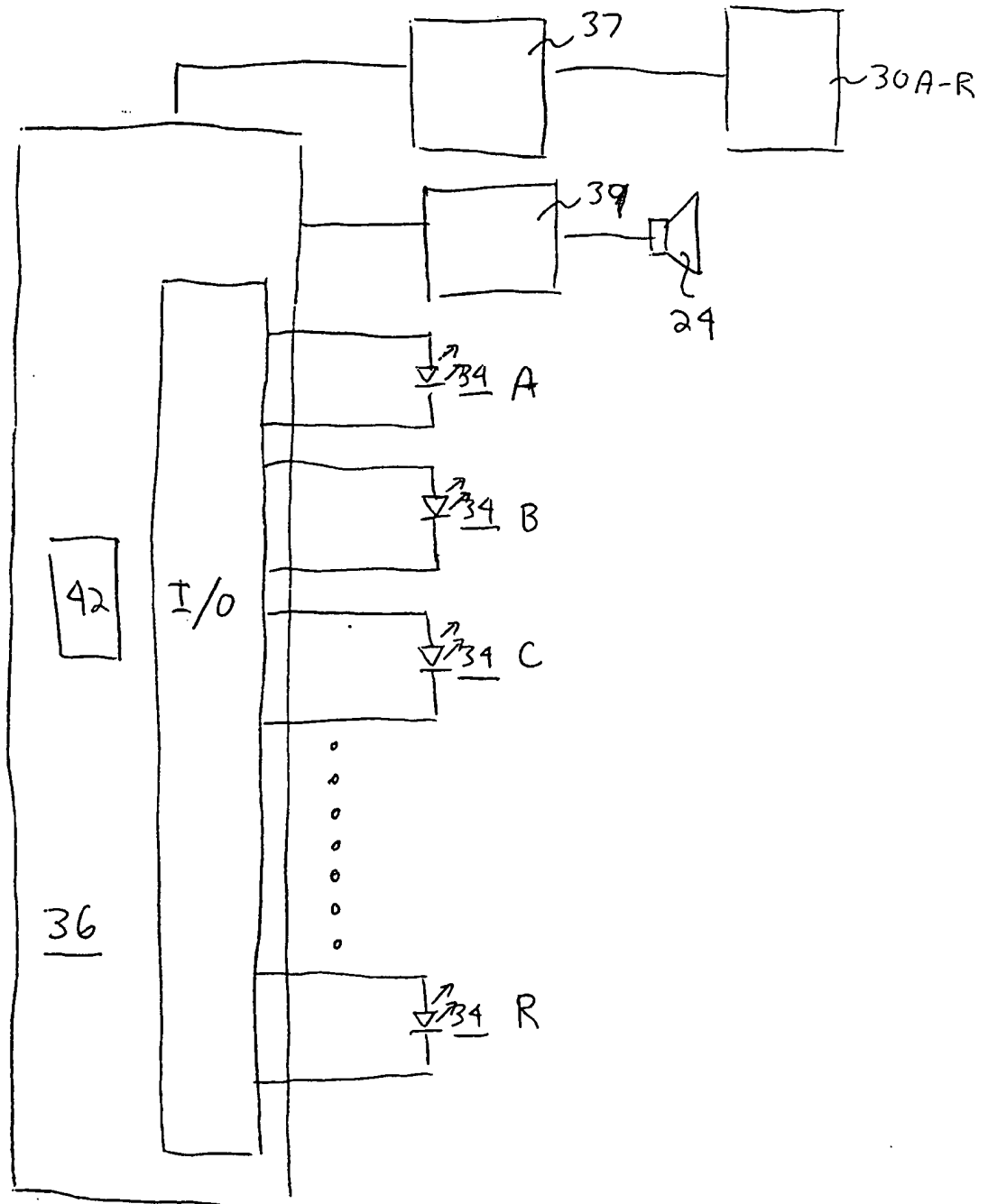


FIG. 3B

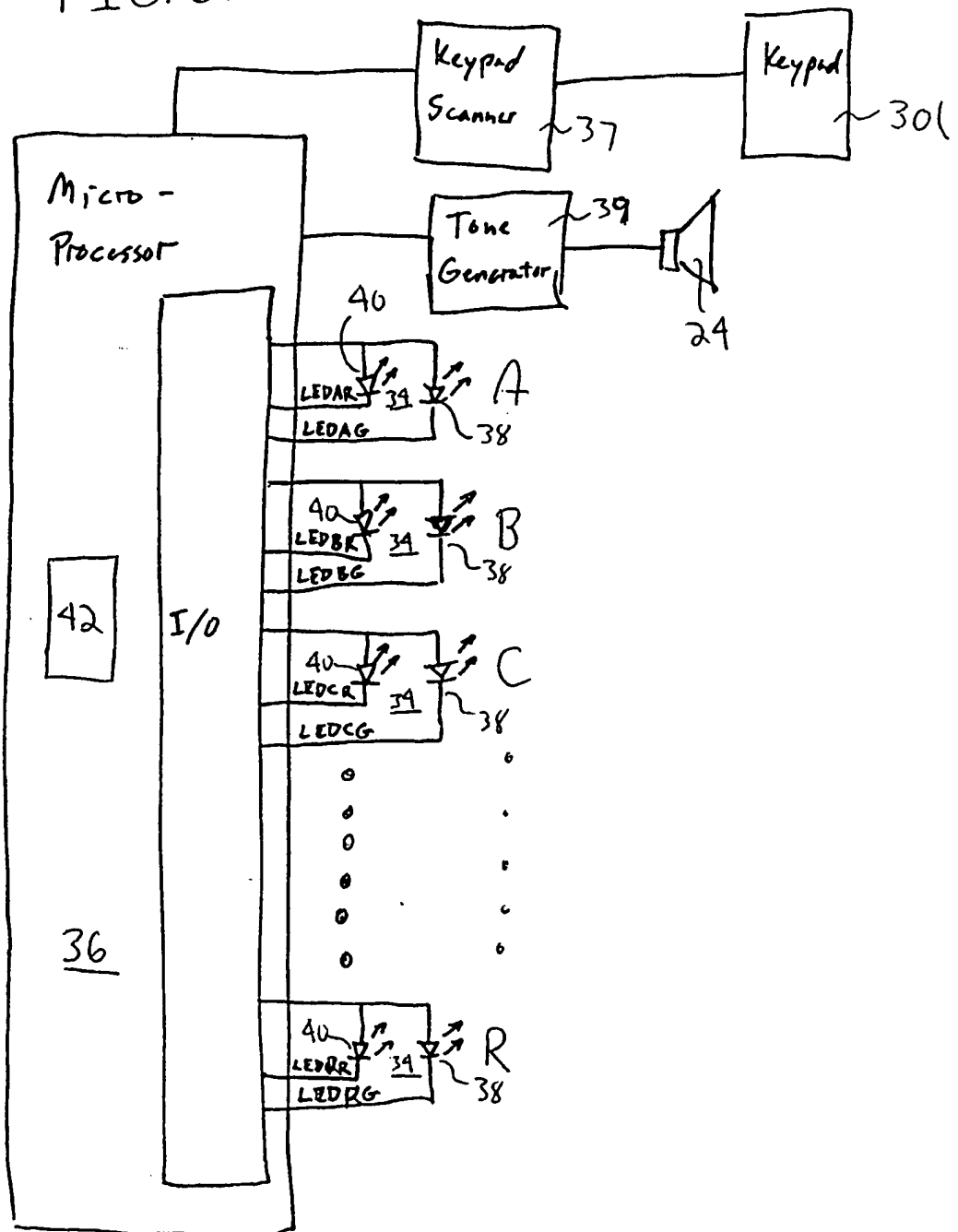


FIG. 4

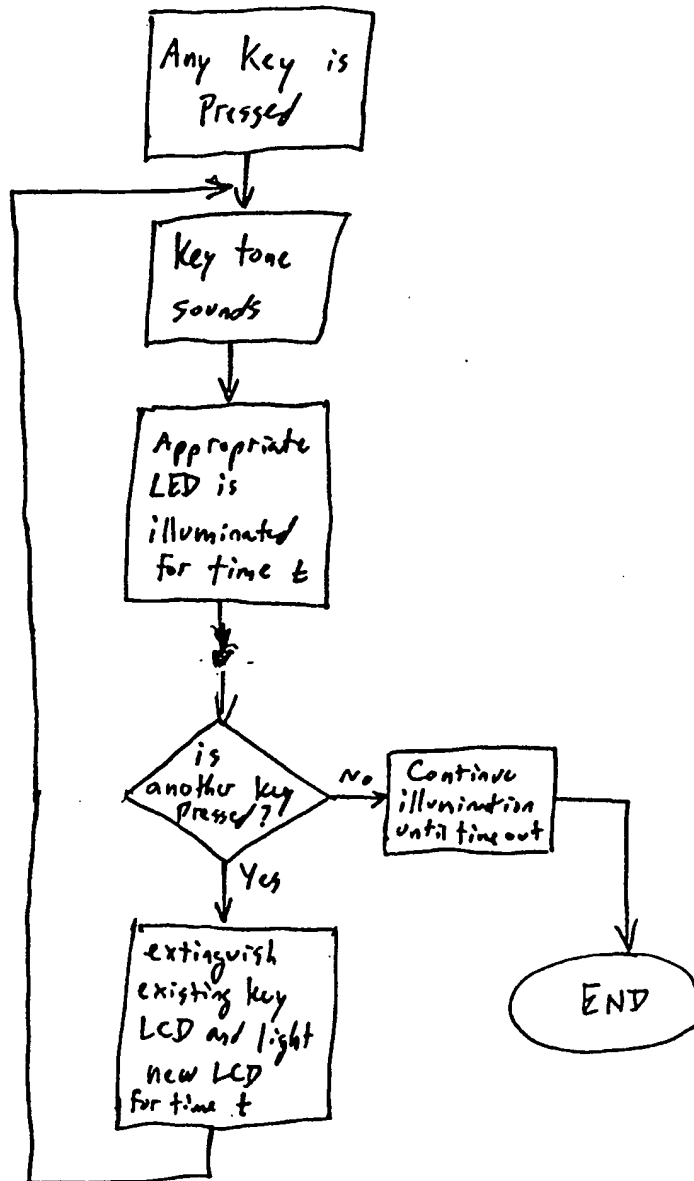
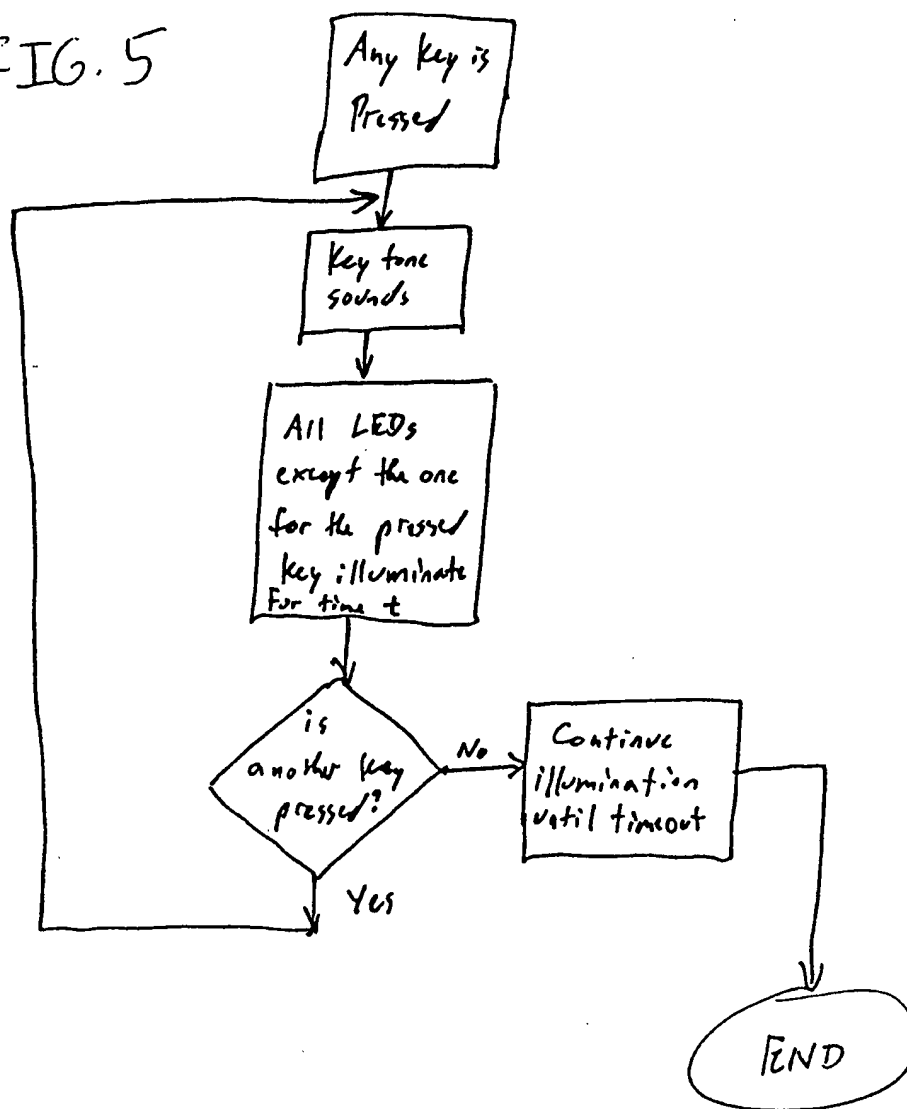


FIG. 5



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FIG. 6

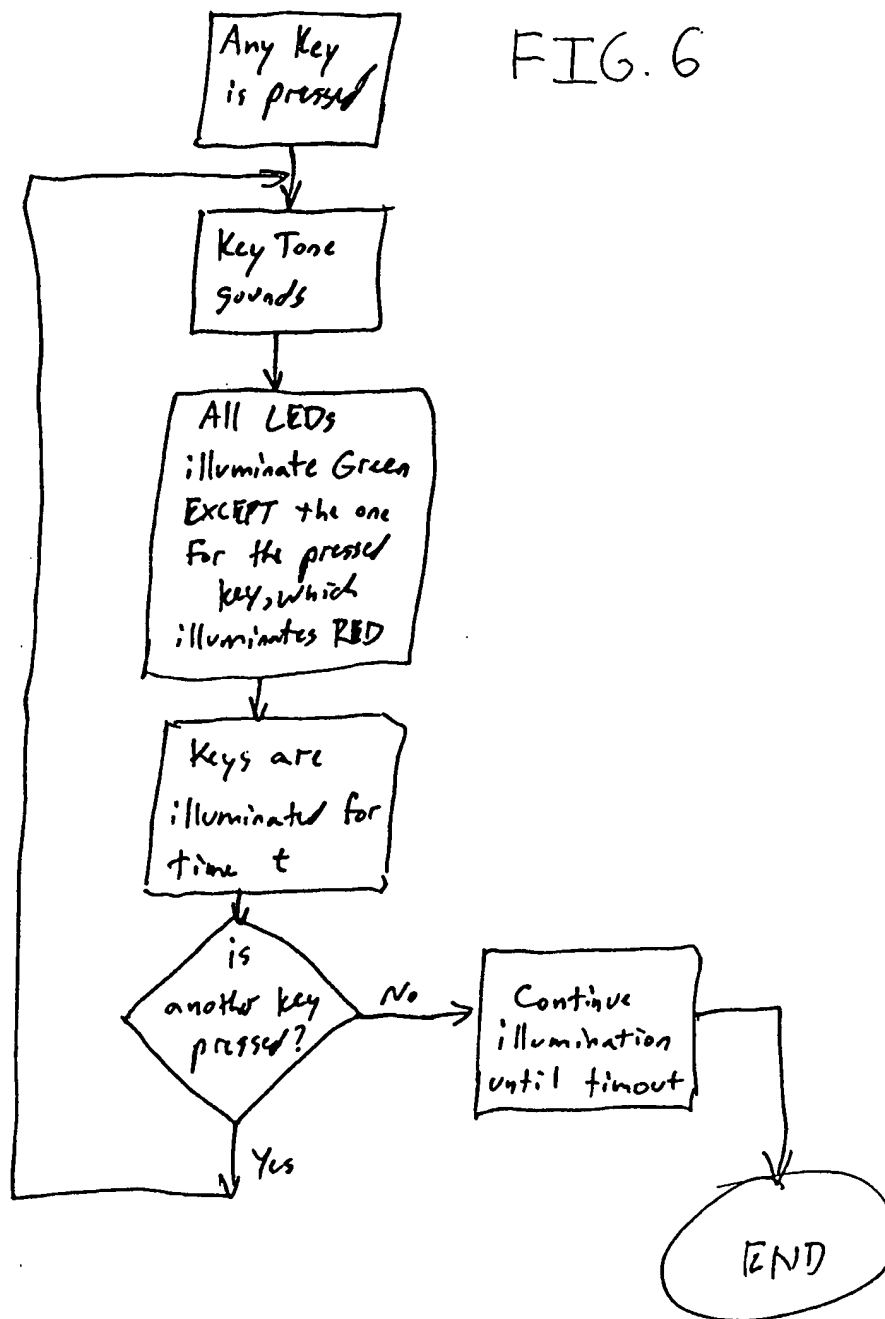
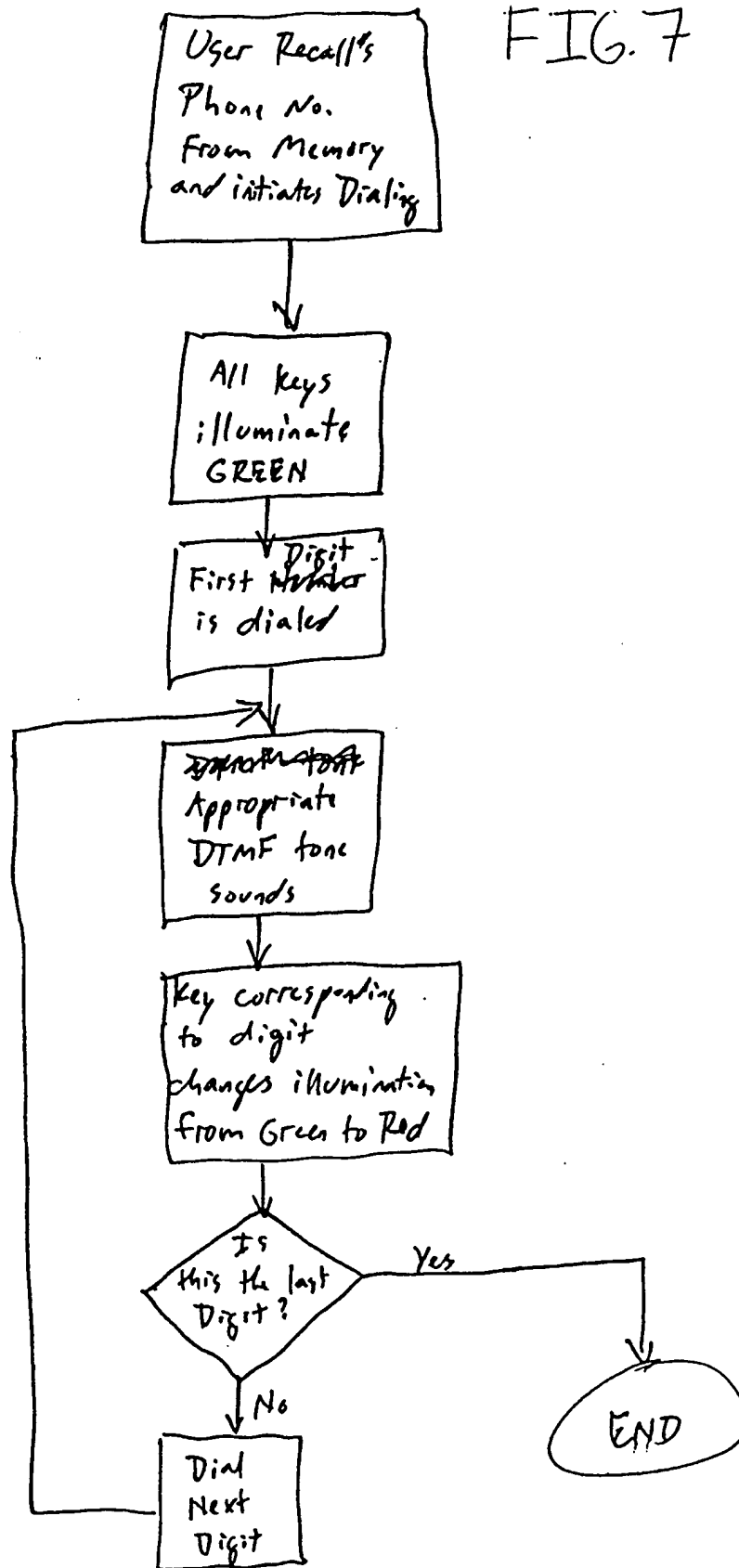


FIG. 7



INTERNATIONAL SEARCH REPORT

Inter. nal Application No

PCT/US 99/21004

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04M1/22

According to International Patent Classification (IPC), or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H04M H01H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 531 034 A (INABA HIROSHI) 23 July 1985 (1985-07-23) abstract column 1, line 10-32 column 3, line 8-20 column 3, line 52-56 ---	1,2,4,5, 10,11
X	DE 38 25 895 A (SIEMENS AG) 1 February 1990 (1990-02-01) claims 1-4; figure 1 ---	1,5,10, 11
	-/--	

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INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 99/21004

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